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Lawrence Livermore National Laboratory
Waste Certification Program

Low-Level Waste Characterization Quality Assurance Project Plan (QAPP)

July 1995

University of California Livermore, California 94551

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Low-Level Waste Program Characterization
Quality Assurance Project Plan
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Abbreviations

AD	Associate Director
ASME	American Society of Mechanical Engineers
AST	Advance Systems Technology
DOE	Department of Energy
DOT	Department of Transportation
EPA	Environmental Protection Agency
EPD	Environmental Protection Department
ES&H	Environmental Safety and Health
HCD	Hazards Control Department
HMPTS	Hazardous Materials Packaging and Transportation Safety
HWM	Hazardous Waste Management
INEL	Idaho National Engineering Laboratory
ISAM	Isotope Separation and Advanced Manufacturing
LLNL	Lawrence Livermore National Laboratory
LLW	Low-Level Waste
NIST	National Institute of Standards and Technology
NQA	Nuclear Quality Assurance
NTS	Nevada Test Site
NVO	Nevada Operations Office
PKE	Process Knowledge Evaluation
QA	Quality Assurance
QC	Quality Control
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RTR	Real Time Radiography
UCL	Upper Confidence Level
WCO	Waste Certification Official

1.0 PROJECT MANAGEMENT

This Quality Assurance Project Plan for the Lawrence Livermore National Laboratory's Low-Level Waste Characterization Project establishes the requirements and provides guidance for assuring that low-level waste is characterized according to:

(1) the U.S. Department of Energy, Nevada Operations Office, *Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements*, NVO-325 (current version), and

(2) the Lawrence Livermore National Laboratory Waste Certification Program *Low-Level Waste Program Certification and Quality Assurance Plan,* M-078-95, the highest level document for the certification program.

The information contained in this QAPP was compiled from several sources, including the QAP identified above. Additional information was obtained from personal interviews with LLNL personnel. This QAPP delineates the required quality of data and the methods designed to attain and ensure that quality while following guidelines recommended in QA/R-5, *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*.

Mandatory program requirements are specified in this QAPP and other project-related documents by the use of the terms "shall," "will," or "must." Information provided as guidance on what constitutes an acceptable means of accomplishing a task is designated by the term "should."

1.1 PROGRAM AND PROJECT ORGANIZATION

The organization chart shown in **Figure 1** is a general overview of the LLNL organization, depicting the structure in which the Low-Level Waste Characterization Project operates. **Figure 2** provides more detail of the organization shown in **Figure 1**. It shows where the Waste Certification Program, of which the Low-Level Waste Characterization Project is a part, fits in the overall organization. Its shaded boxes highlight two of the key participants of the Waste Characterization Project. Responsibilities of Project participants are described below.

1.1.1 Low-Level Waste Generators

At LLNL, a number of research and development facilities generate low-level waste. Currently, the six primary generators are: (1) Plutonium Facility, Building 332; (2) Isotope Separation and Advanced Manufacturing (ISAM) Technology Program; (3) Biology and Biotechnology Research Program, Building 360 Complex; (4) Tritium Facility, Building 331; (5) Experimental Test Site (Site 300); and (6) Nova Laser Facility. In addition to the primary generators, there are waste streams from small or non-routine waste generating facilities, designated as "non-facility-specific" waste streams. And finally, there is low-level waste that was generated at LLNL facilities without certification controls; this waste is designated "low-level legacy waste."

The following sections provide descriptions of the major low-level waste generators at LLNL.

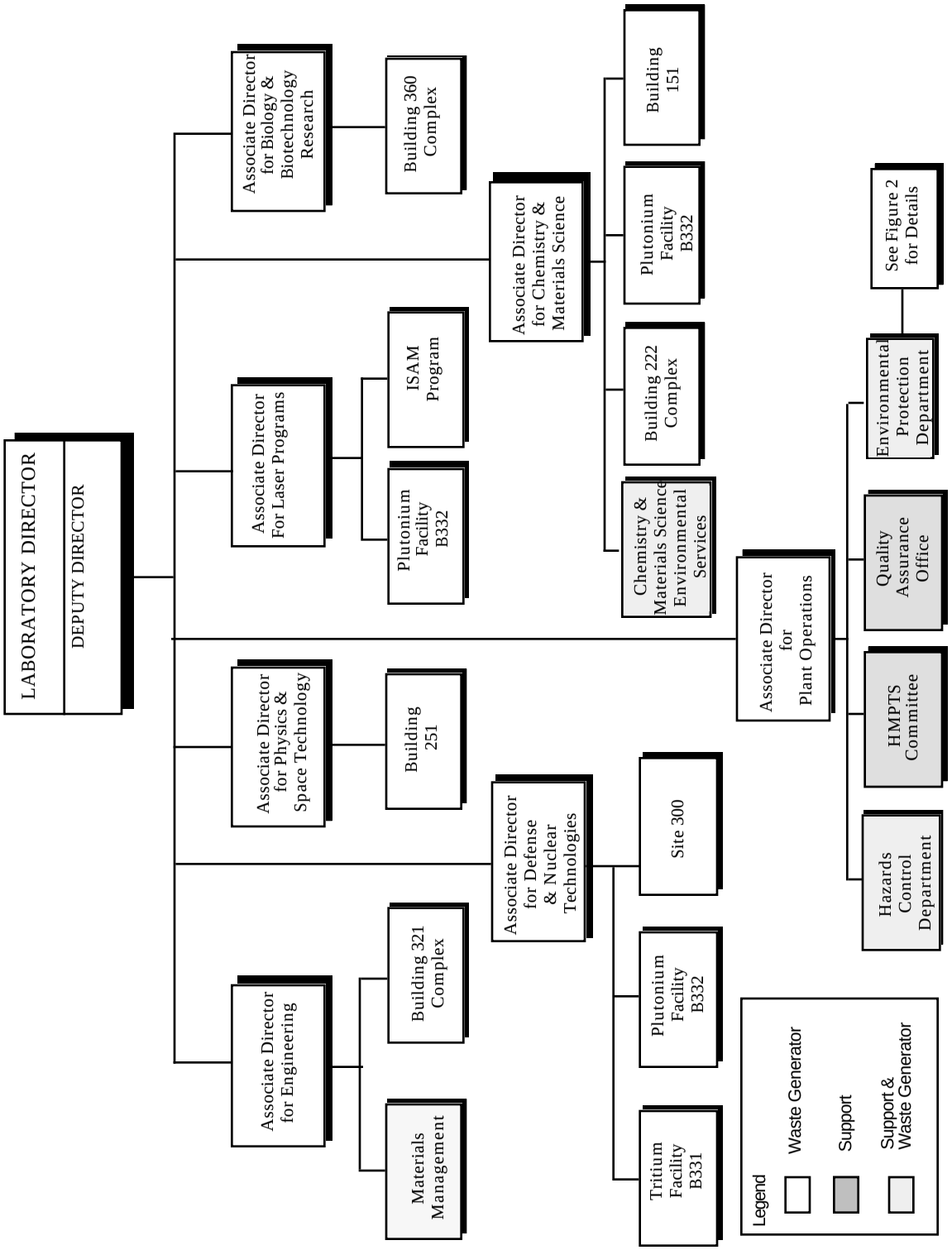

Figure 1. Lawrence Livermore National Laboratory Organization Chart Showing Participants in Waste Certification and Characterization Activities.

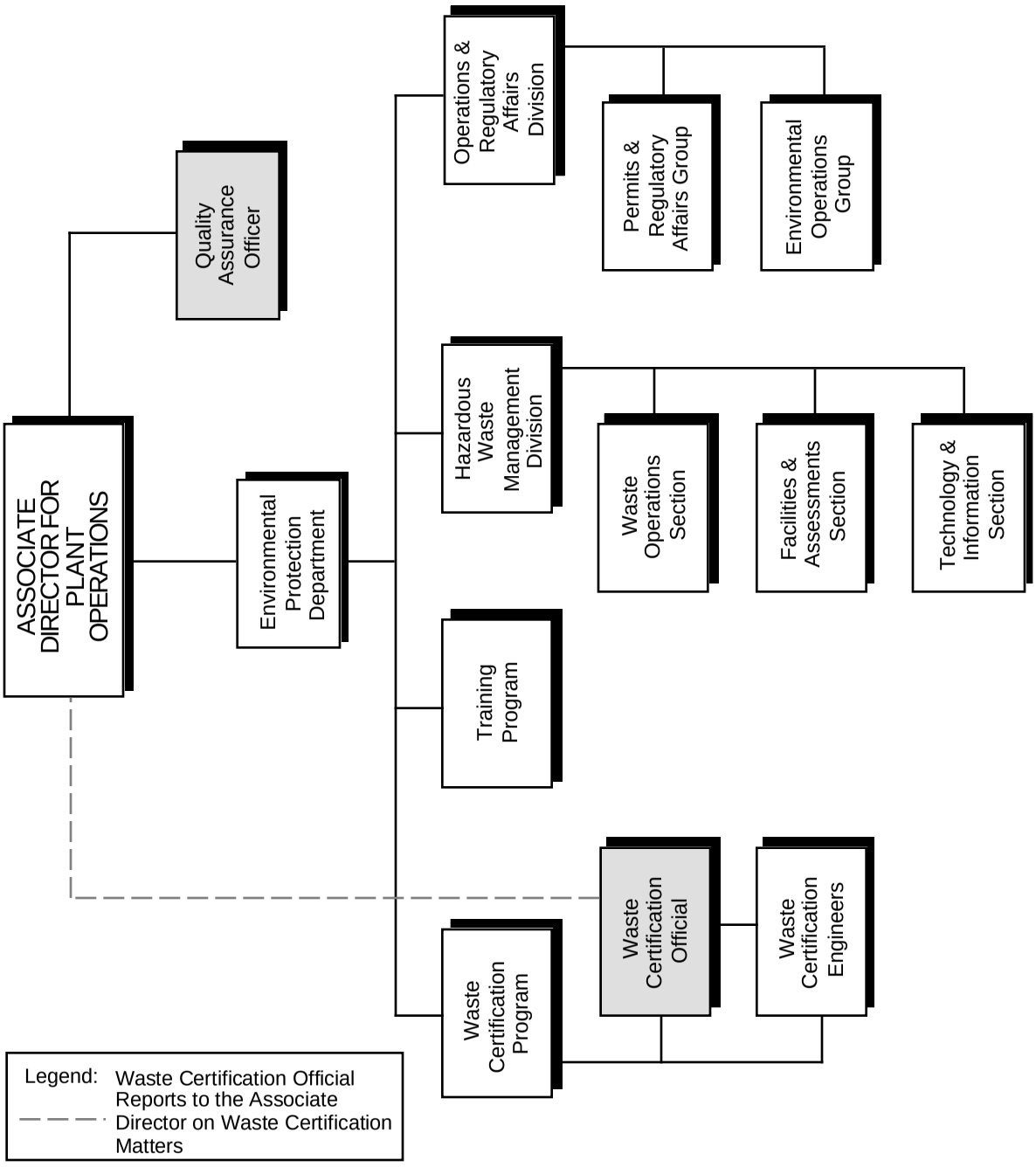

Figure 2. Chart Delineating Organizational Context of Waste Certification Program.

1.1.1.1 Plutonium Facility (Building 332)

Activities in the Plutonium Facility involve, among others, plutonium chemistry and metallurgy. Low-level waste from this facility is potentially contaminated by plutonium and americium; it consists mainly of booties, wipes, and change room trash. The facility manager for the Plutonium Facility is responsible for ensuring its safe and efficient operation.

1.1.1.2 Isotope Separation and Advanced Manufacturing (ISAM) Technology Program

ISAM is a research and development program to demonstrate the atomic vapor laser isotope separation process for uranium enrichment. The process utilizes lasers to selectively photoionize uranium vapor and subsequently extract enriched U-235 for use in commercial power reactors.

The low-level waste from this facility consists mainly of contaminated equipment and associated hardware from separator equipment; waste generated from construction activities typically composed of concrete, wood, sheet rock, floor tile, metal tubing; and laboratory trash, primarily protective clothing, lab ware and wipes.

The AD for Lasers delegates the oversight responsibility for low-level waste management to line management.

1.1.1.3 Biology and Biotechnology Research Program, Building 360 Complex

The Biology and Biotechnology Research Program conducts multidisciplinary, team-oriented, internationally recognized research in health and life sciences in support of national needs. Its work focuses on biological systems, specifically mapping the human genome and investigating the causes of DNA damage. Blood, sperm, and urine are sampled as part of this process. Low-level radioactive nuclides used as tracers for DNA are part of the generated low-level waste. Low-level mixed waste is also generated. The low-level waste from the Program consists mainly of animal bedding and lab trash that is primarily personal protective equipment and glassware.

The AD for this Program delegates the oversight for low-level waste management through line management to the Building 360 Complex facility manager.

1.1.1.4 Tritium Facility, Building 331

The Tritium Facility is used for research and development activities involving tritium-containing systems and tritiated materials. The low-level waste from this facility consists of building debris, equipment, wood, and laboratory trash consisting primarily of personal protective equipment. The facility manager is accountable for the safe and efficient operation of the facility.

1.1.1.5 Experimental Test Site (Site 300)

Site 300 waste is generated during explosives testing operations. The low-level waste from this facility consists mainly of debris from the testing. The primary responsibility for low-level waste operations has been given to the AD for Defense and Nuclear Technology, who delegates this responsibility to line management.

1.1.1.6 Nova Laser Facility

The Nova Laser Facility is dedicated to research and development in fusion power. Its goal is to provide a scientific basis for achieving fusion power, thereby obtaining efficient energy. The specific process being studied is inertial confinement fusion, or the creation of nuclear fusion in the laboratory with lasers. The low-level waste from this facility is mainly lab trash made up primarily of personal protective equipment and small equipment.

The AD for Lasers delegates responsibility for low-level waste management to line management.

1.1.1.7 Non-Facility-Specific Waste Stream Generators

A “non-facility-specific” waste stream consists of equipment, classified waste, sealed sources, empty radioactive-contaminated containers, and lab trash generated during a one-time process or in a very limited quantity. Such waste streams originate from non-routine processes, without the certification controls described in the *Low-Level Waste Program Certification and Quality Assurance Plan* (LLNL, 1994).

1.1.1.8 Low-Level Legacy Waste Generators

LLNL has developed a program to characterize and certify low-level legacy waste from throughout the site that was generated without a certification process or controls from the Waste Certification Program. The characterization and certification of low-level legacy waste is a three-step process that includes process knowledge evaluation, real time radiography, or visual evaluation, and radiological characterization. The bulk of this waste is stored at LLNL's treatment, storage, and disposal facility, where it is characterized and certified in accordance with the *Low-Level Waste Program Certification and Quality Assurance Plan* (LLNL, 1994).

1.1.2 Environmental Protection Department

The Environmental Protection Department ensures that LLNL meets environmental responsibilities as stipulated in environmental legislation, regulations, and DOE Orders, and collaborates with LLNL programs to maintain adequate protection of the environment. As shown in **Figure 2**, the organizations with primary oversight responsibilities for the Waste Certification Project are within EPD. EPD’s overall responsibilities are:

- Developing and maintaining LLNL environmental policies, plans, guidelines, and practices;
- Educating and training LLNL employees on environmental issues;
- Guiding LLNL programs in complying with environmental laws and regulations;
- Representing LLNL to the public and to federal, state, and local regulatory agencies on environmental issues;
- Assisting LLNL program personnel to manage and minimize hazardous and radioactive waste;
- Performing environmental monitoring of LLNL operations;

- Determining the extent of environmental contamination from past activities;
- Cleaning up environmental contamination to acceptable standards;
- Responding to emergencies that impact the environment and providing guidance for cleanup, sampling, and reporting.

1.1.2.1 Operations and Regulatory Affairs Division

The Operations and Regulatory Affairs Division provides guidance to low-level waste generators on waste characterization, handling, and packaging. In particular, field environmental analysts from the Environmental Operations Group within ORAD advise generators in the proper characterization of low-level waste.

1.1.2.2 Hazardous Waste Management Division

The HWM Division is responsible for the disposition of all LLNL-generated waste, including shipment for final disposal. HWM manages the Solid Waste Facility, which is involved with all low-level waste handling and is used for storing and inspecting containers, both before and after they have been filled.

1.1.2.2.1 Legacy Waste Program

The Legacy Waste Program within HWM coordinates many of the HWM activities with the Waste Certification Official, Materials Management Section, Hazards Control Department, facility managers, and the waste generators. The Legacy Waste Program is responsible for the characterization of legacy waste in conjunction with the Waste Certification Program. The Legacy Waste Program manages the real time radiography contract with Advance Systems Technology to ensure that the performance of the contract and management of the data meet Waste Certification Program and other requirements as detailed in this document.

1.1.2.3 Training Program Manager

The Training Program Manager is responsible for ensuring that LLNL employees receive appropriate training on environmental responsibilities and issues, and for informing management about pending changes in environmental regulations impacting LLNL's activities. Training in particular is provided to all LLNL personnel performing environmental activities, including waste characterization, and training records must be maintained for them.

1.1.3 Waste Certification Official

The Waste Certification Official is responsible for:

- Certifying that each low-level waste shipment meets applicable storage or disposal facility requirements;
- Approving low-level waste characterization activities;
- Reviewing and approving the site QAPP before its implementation;
- Implementing the QAPP;

- Annually reviewing the QAPP to determine if changes are required;
- Revising the QAPP and applicable operating procedures in accordance with the approved changes to the Low-Level Waste Certification and Quality Assurance Plan;
- Evaluating and approving all site-specific changes to QA documents and applicable operating procedures;
- Notifying the DOE/Oakland Area Office (DOE/OAK) of site-specific changes to QA documents.

1.1.4 Site Project QA Officer (Waste Certification Program Legacy Waste Coordinator)

The Site Project QA Officer (who, in the case of legacy waste, is the Waste Certification Program Legacy Waste Coordinator) is responsible for:

- Verifying the implementation of the QA requirements for the Waste Certification Program;
- Providing necessary day-to-day guidance to the project staff on quality-related matters;
- Identifying and reporting quality problems to the Waste Certification Official;
- Performing data validation and data usability assessments.

1.1.5 Site Project Manager (Legacy Waste Program Leader)

The Site Project Manager (who, in the case of legacy waste characterization, is the Legacy Waste Program Leader) oversees day-to-day characterization activities and any contracts associated with the project, and is responsible for:

- Reviewing and approving the site QAPP;
- Overseeing project activities at the facility;
- Approving and accepting final products and deliverables;
- Implementing specific characterization techniques.

1.2 PROGRAM DOCUMENTS

The program includes a hierarchy of documents that will guide QA activities. **Figure 3** shows the hierarchy and relationship of program QA documents.

1.2.1 Low-level waste Certification and QA Plan (QAP)

The *Low-Level Waste Certification and Quality Assurance Plan* is the highest-level QA document for the project and defines general QA requirements for program activities. The QAP is implemented through a series of procedures referred to as WCP Implementing Procedures.

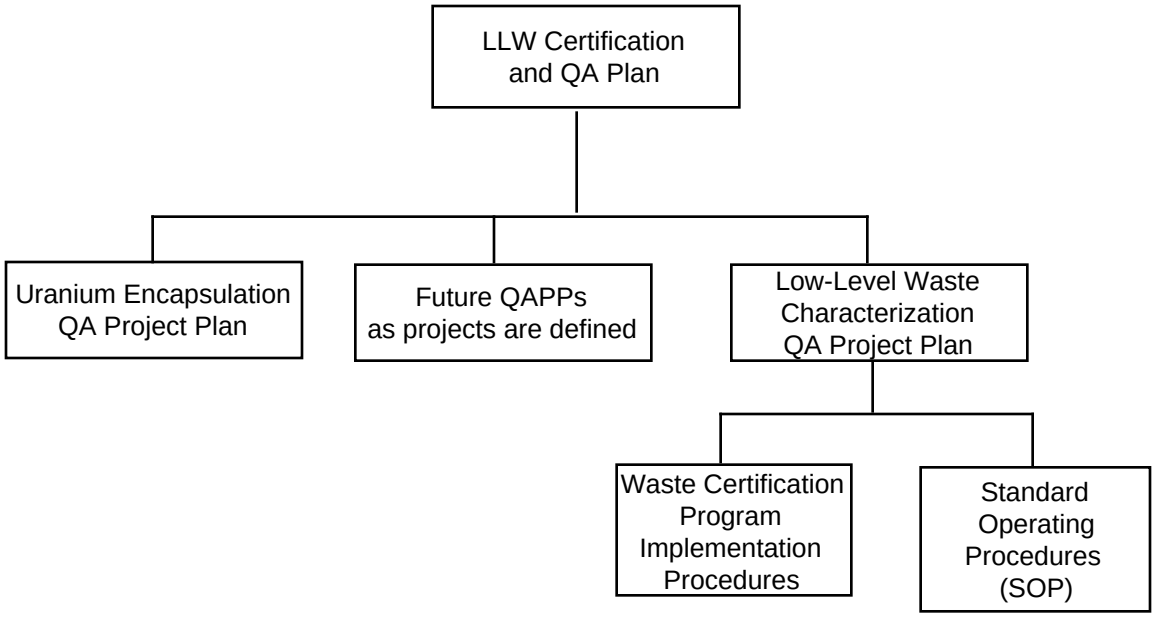

Figure 3. Hierarchy of Low-Level Waste Characterization QA Documents.

1.2.2 Low-Level Waste Characterization QA Project Plan (QAPP)

This QAPP describes activities undertaken at LLNL to characterize low-level waste. Currently, only the real time radiography of low-level waste is addressed. Future revisions will include other waste characterization techniques. This QAPP includes performance-based QA/QC criteria that must be met by waste characterization activities.

1.2.3 Procedures

Table 1 lists the procedures that provide requirements and guidance for QA-related waste characterization activities as they relates to this project and real time radiography. Procedures include those used in the process of characterization, evaluating waste against the waste acceptance criteria, and waste handling and packaging.

1.2.1 Document Review, Approval, and Control

Documents that specify quality requirements or prescribe activities shall be reviewed, approved, modified, and controlled in accordance with the procedures listed in **Table 2**.

The preparation, issue, and revision of documents that specify quality requirements or that prescribe activities affecting quality for the Project shall be controlled to assure that correct and current documents are used and referenced. All quality documents for the Project shall be reviewed prior to approval and issuance. This review shall consider, as appropriate, the technical adequacy, completeness, and correctness of the documents and the inclusion of appropriate quality requirements. Approval shall be indicated by a signature and date page included in each document. All members of the site project staff shall be responsible for reporting any obsolete or superseded information to the Waste Certification Official. The QAPP and Waste Certification

Table 1. Procedures Used as Guidance for the Low-Level Waste Characterization Project.

Procedure No.	Procedure Title
WCP-1	Audits
WCP-2	Corrective Action
WCP-3	NCAR
WCP-4	Records Control
WCP-8	Management of LLW by LLW Generators
WCP-14	Process Knowledge Evaluation for Non-Facility Specific Waste Streams
WCP-15	Preparation of Waste Characterization Data Deliverable Packages
WCP-18	LLW Packaging for Non-Facility Specific Waste Streams
WCP-19	Process Knowledge Evaluation for Non-Facility Specific Waste Streams
WCP-28	The Characterization and Certification of low-level legacy waste
WCP-31	Data Validation of Real Time Radiography

Table 2. Waste Characterization Project Document Control Procedures.

Procedure No.	Procedure Title
WCP-5	Document Control
WCP-6	Procedure Development and Revision

Program Implementing Procedures shall be revised in accordance with changes in the *Low-Level Waste Certification Program and Quality Assurance Plan*. The Waste Certification Official will notify pertinent staff of any changes.

1.3 PROBLEM DEFINITION/BACKGROUND

The proper management of low-level waste requires that the waste be adequately characterized to ensure that it:

(1) Meets the requirements of the intended disposal facility.

(2) Is characterized to determine the proper regulatory status of the waste. Low-level waste disposal and treatment facilities are prohibited from accepting low-level waste containing hazardous components regulated under the Resource Conservation and Recovery Act.

(3) Is properly characterized for transportation purposes to ensure that the waste is packaged correctly and meets all the Department of Transportation regulatory requirements.

Low-level waste characterization, which includes obtaining chemical, radiological, and physical data, is a primary component of the waste certification process. The waste allowed to be disposed of at low-level waste disposal facilities is waste for which adequate waste

characterization data are available. This QAPP establishes waste testing, sampling, and analytical techniques that may be used to support the proper characterization and certification of low-level waste for disposal.

1.4 PROJECT DESCRIPTION

The project consists of activities related to the characterization of low-level and low-level mixed waste. This document will be updated to include characterization activities as they are developed initially. This plan will be limited initially to real time radiography operations.

Real time radiography is used to verify low-level legacy waste container contents at LLNL. The activities take place within the HWM storage facility and are performed by an outside contractor.

Low-level legacy waste is low-level waste that was generated without specific controls, as defined by the Waste Certification Program. Primarily this waste was generated before implementation of the quality assurance/quality control requirements specified in a QAPP. In compliance with this QAPP, characterization of low-level legacy waste shall be conducted in accordance with procedures that have been approved by the applicable disposal facility. The characterization will demonstrate that the low-level legacy waste does not contain items prohibited by the disposal facility's waste acceptance criteria.

1.5 DATA QUALITY OBJECTIVES FOR MEASUREMENT DATA

Data quality objectives are qualitative and quantitative statements that clarify the technical and quality objectives of waste characterization data. They define data appropriateness and specify the levels of decision errors that are tolerable. They prescribe the quality and quantity of data needed to support decisions. Data quality objectives are derived from a strategic planning process based on the scientific method; they are used in preparation for data collection activities.

The data obtained through waste characterization will be used to assure that regulatory and disposal site requirements are met with regard to:

1) Disposal site waste acceptance criteria (WAC);

2) General waste characterization requirements of 40 CFR 260 - 280;

3) Transportation of radioactive waste per 49 CFR 171-173.

The action levels to support compliance decisions for each waste characterization technique are presented in the technique-specific sections. These specific sections also state the requirements for precision, accuracy, bias, method detection limit, program-required detection limits, total uncertainty, completeness, comparability, and representativeness, if applicable, in the form of quality assurance objectives.

The data quality objectives for low-level waste characterization activities are as follows. (Note that at the present time radiography is the only technique being addressed.)

1.5.1 Disposal Site Waste Acceptance Criteria

- Radiography

To classify/verify that the low-level legacy waste inventory meets the disposal facility's waste acceptance criteria for physical waste form and that the waste is consistent with descriptions provided by generator personnel.

1.5.2 General Waste Characterization Requirements

- Radiography

To verify that the physical form of the low-level legacy waste is consistent with process knowledge data provided for waste characterization.

1.5.3 Transportation

- Radiography

To verify that the physical waste form meets packaging and shipping requirements.

1.6 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATIONS

Before performing activities that affect quality, all LLNL project staff shall receive indoctrination into the scope, purpose, objectives, and the specific quality assurance objectives of the assigned task in accordance with the requirements of the *LLNL Training Program Manual*. Personnel assigned to perform real time radiography shall have the education, experience, and training applicable to the functions associated with the work. All individuals participating in the project must receive the training course EP 0110, "LLW Generation and Certification," prior to generating or handling low-level waste. Evidence of personnel proficiency and demonstration of competence in the task(s) is demonstrated through a performance-based examination. Waste characterization personnel must complete EP 0110 every two years.

The type and date of all training and the documented proficiency of each individual shall be recorded in the LLNL-wide database known as Laboratory Repository of Completed Courses (LROCC) to which EPD provides input. Additionally, the database known as Training Requirements and Qualifications (TRAQ) monitors the training expiration dates of all records. In this capacity, TRAQ is used for notifying line managers of personnel training expiration dates. In accordance with the *LLNL Training Program Manual*, it is the line manager's responsibility to identify any additional training that may be required and to ensure that all personnel maintain proficiency in the work performed.

1.7 DOCUMENTATION AND RECORDS

A data/records management system shall be defined, implemented, and enforced for the project in accordance WCP-4, "Records Control," to maintain evidence of the conduct and quality of work. This system shall include the management of all field, laboratory, and site project files.

1.7.1 LLNL Records Management

The project shall develop and maintain a record management system for all project-related QA/QC information, raw data, and records related to waste characterization. Records must be legible, clearly identified, retrievable, and secured in a controlled-access facility.

1.7.2 Record Retention

Documentation of all aspects of QA/QC associated with the project will be retained in site project files. At a minimum, site project files shall include items listed in **Table 3**. The specific forms that must be retained as project files are listed in WCP-4, “Records Control.” Site project files can include both files and real time radiography data under the control or within the boundaries of LLNL. Additionally, subcontractors shall forward any applicable items listed in **Table 4** to the Site Project Manager for storage in the site project files.

Site project files shall be maintained in facilities that provide a suitable environment to minimize deterioration or damage (e.g., from temperature, excessive light, or moisture). Access to these facilities and retrieval of information for reference or use outside of the storage area shall be documented and controlled. Special processed records (i.e., radiographs, photographs, negatives, microfilm, and optic and magnetic media) must be physically protected from damage or deterioration from excessive light, stacking, electromagnetic fields, temperature, and humidity in accordance with NQA-1, Supplement 17S-1 (ASME, 1994).

1.7.3 Waste Operations Records

Waste operations facilities (i.e., waste management and radiography) must maintain records management systems for all applicable QA/QC records pertinent to their operation. These systems must provide record control and retention comparable to that outlined for the Waste Certification Program files and site project files.

1.8 PROCUREMENT

LLNL shall implement procedures to ensure that procured items and services meet established requirements and perform as specified in WCP-11, “Procurement Document Preparation and Control.” These procedures shall address control of purchased items, services, subcontractors, and suppliers. Procurement controls specified by this QAPP are applicable to equipment and services that directly affect the quality of real time radiography.

Table 3. Minimum Required Project Records Maintained in Site Project Files.

Project Records
Real Time Radiography Data Collection (WCP-0078)
Video tapes of real time radiography
Nonconformance and corrective action documentation
Audit plans, reports, responses, and final closure of corrective actions
Documentation of revisions or changes to the quality assurance program plans or quality assurance project plans

Table 4. Additional Project Records from Subcontractors for Site Project Files.

Project Records
All pertinent incoming and outgoing correspondence, memoranda, and telephone records related to QA/QC
Procurement records
All field sampling data forms and records of data reduction
Calibration records
Data reduction, validation, and reporting records
Documentation of calculations and computer programs and associated verification
Reference materials relevant to the program
Reports and data transmittals
Nonconformance and corrective action documentation
Audit plans, reports, responses, and final closure of corrective actions
Quality assurance reports to management
Training/qualification records
Documentation of revisions or changes to the quality assurance program plans or quality assurance project plans

1.8.1 Procurement Document Control

Procurement documents shall specify the quality elements for which the supplier is responsible and shall require suppliers of equipment to have a QA program that meets or exceeds the applicable criteria of this QAPP. If suppliers do not have a QA program that addresses the requirements included herein, they can agree to comply with the requirements of this document. The Waste Certification Official will be responsible for verifying supplier compliance with applicable QA/QC requirements.

1.8.2 Control of Purchased Items and Services

The procurement of items and services that directly affect the quality of waste characterization data shall be controlled by the Project to assure conformance with specified requirements. Such control shall include, as appropriate, the evaluation of selected service or equipment; review and evaluation of the QA/QC provided by the supplier; and inspection, audit, and examination of items or services upon delivery or completion.

The purchase or use of equipment and replacement parts or design modifications to existing equipment used for the Project shall be documented and controlled. The methods for accepting material or equipment from a supplier may include source verification, receiving inspection, supplier certificate of conformance, post installation test, or a combination thereof.

1.8.3 Control of Subcontractors

Performance and compliance requirements of this QAPP that directly affect the quality of waste characterization data must be communicated to subcontractors and shall be part of subcontractor

agreements associated with the Project. LLNL shall perform and document the results of QC inspections of its subcontractor activities to verify compliance with the performance requirements included in this QAPP. Each subcontractor shall, as necessary, complete the necessary training required for implementing the QAPP requirements. If necessary, prequalification audits may be performed by LLNL personnel to determine subcontractor acceptability. Subcontractors shall complete and submit copies of all project-related records to the Site Project Manager.

To verify subcontractor conformance to the Project QA/QC requirements, LLNL shall, as necessary, review documentation prepared by subcontractors and perform audits of subcontractor activities. Subcontractors shall provide access to their work areas and records for inspection and auditing. Inspections or audits shall be performed, and the results and tracking of corrective actions to final resolution shall be documented as required by WCP-1, “Audits,” WCP-2, “Corrective Action,” and WCP-3. “Nonconformance Reporting.”

1.9 WORK PROCESSES

All low-level waste characterization in support of the Project shall be performed using approved instructions or procedures. Personnel conducting work shall be trained to implement these procedures in accordance with the requirements specified in Section 1.6 of this QAPP.

1.9.1 Control of Processes

Processes affecting the quality of the Project, which shall be controlled through the implementation of this QAPP and Waste Certification Program Implementing Procedures, include equipment testing, inspection and maintenance, equipment calibration, and data management.

1.9.2 Computer Hardware and Software

Computer software and hardware/software configurations specifically developed as part of the Waste Characterization Program shall be verified, validated, tested, and documented in accordance with the requirements of ASME NQA-1 Subpart 2.7 (ASME, 1994). Commercially available software does not require testing prior to use.

2.0 Data Validation, Usability, and Reporting

Certain steps are necessary to ensure that waste characterization data meet the level of quality needed for compliance with Program requirements. These steps will take place both at the data generation and the waste certification level. This system of data validation will ensure that proper data generation and management procedures are followed.

2.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

Data review ensures that raw data are properly collected and reduced. Data validation confirms that the data satisfy the requirements established by the user. Data verification is a performance check on the data review and data validation processes.

2.1.1 Data Generation Level

One hundred percent of data collected by the analytical laboratory(s) or real time radiography shall be reviewed by independent technical reviewer(s), supervisors, and a QA officer. These individuals will perform reviews of the data as explained in WCP-28. The Characterization and Certification of Low-Level Legacy Waste." Part of the review will consist of signature release of the data.

2.1.2 Project Level

The Waste Certification Official will also review and signature release 100 percent of the data as described in WCP-28 ("The Characterization and Certification of Low-Level Legacy Waste"). In addition, the Waste Certification Official shall repeat the data-generation-level review, validation, and verification for a minimum of one drum semiannually.

2.2 VALIDATION METHODS

Qualitative and quantitative data validation shall be performed as described in WCP-31, "Data Validation of Real Time Radiography." Validation methods will quantitatively assess precision, accuracy, completeness, comparability, and method detection limit (as appropriate). A qualitative determination of representativeness will also be performed. The data-generation-level QA officer shall perform quantitative data validation according to the procedure referenced above. Visual examination will be used to confirm the waste description determination based on radiography. The Site Project Manager shall verify that random samples collected from within a waste stream are representative of it. The statistical methods for determining sample populations are outlined in Section 4.0 of this QAPP. Where applicable, waste characterization techniques used to ensure representativeness of a particular sample are included in Section 6.0.

2.2.1 Precision

The qualitative determinations made during radiography do not lend themselves to statistical evaluation of precision. However, previous testing at the Rocky Flats Plant and at INEL indicates that radiography operators can provide estimated inventories of waste items in a waste container, which is demonstrated when radiography data are compared to the actual contents of the waste container during a visual examination (Zeigler and Harder, 1993).

2.2.2 Accuracy

The accuracy with which the waste container contents can be determined must be documented through visual examination of a randomly selected statistical subpopulation of drums (Section 4.1.2). The percentage of containers which require a new description after visual inspection will be calculated and reported by the site QA officer as a measure of accuracy.

2.2.3 Completeness

A recording of the radiography examination and a radiography data form, validated according to the requirements in Section 2.0, must be obtained for 100 percent of the waste containers at LLNL.

2.2.4 Comparability

The waste container contents determined by radiography must be compared with the waste container contents determined by visual examination (Section 4.3 of this QAPP). The comparability of generated radiography data must be enhanced by using standardized radiography procedures and qualifying operators in accordance with the requirements of this QAPP (as discussed in Section 6).

2.3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Analytical results and the program data quality objectives must be reconciled. This is done to assure that data are of sufficient quality to support the regulatory programs described in Section 1.3 of this QAPP. Reconciliation at the project level will be performed by the Site QA Officer.

2.3.1 Reconciliation at the Project Level

The Waste Certification Official is responsible for ensuring that all data generated at LLNL meet the data quality objectives provided in Section 1.5. WCP-31, “Data Validation of Real Time Radiography,” describes the procedures to be followed by the Waste Certification Official in performing this reconciliation, which is used to evaluate whether sufficient data have been collected to determine the following:

- Waste description;
- Whether or not prohibited items as established by the waste disposal site are included in the waste container;
- Whether the waste stream can be classified as hazardous or nonhazardous at the 90-percent confidence level;
- Whether a sufficient number of waste containers has been visually examined to determine with a reasonable level of certainty that the UCL_{90} of the average miscertification rate is less than 14 percent.

If the Waste Certification Official determines that insufficient data have been collected, additional data collection efforts will be requested by memorandum.

2.4 DATA REPORTING REQUIREMENTS

Generated data shall be transmitted by hard copy to the Waste Certification Official. The following are the hard copy transmittals.

- Container Inspection Card (WCP-0014)
- Waste Parcel Log Card (WCP-0016)
- Waste Package Disposal Requisition (WCP-0018)
- Process Knowledge Evaluation (WCP0067)
- Low-Level Legacy Waste Report (WCP-0069)
- Low-Level Legacy Waste Confirmation Report (WCP-0065)
- Low-Level Legacy Waste Radiological Characterization Results (WCP-0068)
- Low-Level Legacy Waste Reevaluation (WCP-0066)
- PKE Supplemental Radiological Characterization (WCP-0067)
- RTR Data Collection (WCP-0078)
- Visual Data Collection (WCP-0083)
- Low-Level Legacy Waste Data Package Checklist (WCP-0081)
- RTR Weekly Surveillance (WCP-0082)
- RTR – Visual Data Comparison (WCP-0080)

3.0 Measurement and Data Acquisition

This QAPP and related SOPs shall be used for implementing the methods specified in Section 6 and in future waste characterization techniques. All methods shall be performed by qualified personnel. A brief explanation of the requirements common to all methods is presented below.

3.1 QUALITY ASSURANCE OBJECTIVES

Data quality objectives are presented for each testing, sampling, and analytical method under each waste characterization technique. The objectives are presented in terms of precision, accuracy, method detection limit, program required quantification limit, completeness, comparability, and representativeness, as applicable. Data that meet quality assurance objectives will support the data quality objectives presented in Section 1.5 and, in turn, support the compliance activities presented in Section 1.3.

3.2 METHODS REQUIREMENTS

LLNL shall follow prescribed testing, sampling, and analytical methods so that processes affecting waste characterization quality are controlled. Each method has equipment requirements, implementation or extraction requirements, decontamination procedures, and specific performance requirements.

Supplies and consumables that support the testing, sampling, and analytical method may include sampling containers, reagents, gases, deionized water, decontamination materials, hoses, and other ancillary equipment. If supplies or consumables of a certain material type, dimension, or purity are critical to the quality of the data, these criteria will be specified.

3.3 QUALITY CONTROL REQUIREMENTS

The QC requirements for each testing, sampling, and analytical method include the collection and analysis of equipment blanks, field or laboratory blanks, field or laboratory duplicates, replicate scans, field reference standards, and laboratory control samples. Testing, sampling, and analytical laboratory personnel shall be responsible for collecting and analyzing the appropriate type and quantity of QC samples. The Site Project Manager and Site Project QA Officer will evaluate results and will ensure that Program objectives have been met.

3.4 EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Equipment must be tested and inspected to assure the quality of data being generated. Routine inspection and maintenance of testing, sampling, and analytical equipment are required to ensure proper operation and to provide quality data. The status of inspection and test activities shall be documented to prevent the inadvertent use of malfunctioning equipment during waste characterization activities. For example, if a particular piece of equipment is found to be malfunctioning, a tag shall prevent its use in waste characterization activities until it is repaired.

Preventive maintenance must have two aspects: (1) a schedule of preventive maintenance activities to ensure the accuracy of measurement systems and minimize downtime, and (2) a collection of critical spare parts and backup systems and equipment. Field and laboratory equipment and instrumentation shall be maintained in accordance with manufacturers' specifications or with applicable test specifications; the maintenance shall be documented.

3.5 EQUIPMENT CALIBRATION AND FREQUENCY

Routine calibration ensures that equipment functions properly and provides documentation of the measurements. Calibration shall be conducted using certified equipment or standards, as appropriate, with known valid relationships to nationally recognized performance standards. If no nationally recognized standards exist, such as in the case of radiography, the basis for the calibration must be documented.

Calibrated equipment must be uniquely identified by the manufacturer's serial number, a calibration system identification number, or some other means. This identification, along with a label/record indicating when the next calibration is due, must be attached and be traceable to the equipment. Personnel must check the calibration status of all such equipment before use.

Reference standards (physical and/or chemical) must be used for calibration. Physical standards must be stored separately from working measurement and test equipment, where possible. Equipment that cannot be calibrated must be removed from service and isolated to prevent inadvertent use, or it must be tagged to indicate that it is out of calibration. Such equipment must be repaired and recalibrated to waste characterization requirements before further use.

Instrument instruction manuals must be kept on file for reference purposes. Records must be prepared and maintained for each piece of calibrated equipment to indicate that established calibration procedures have been followed. These records must be completed and maintained in accordance with WCP-22, “Control of Measurement and Test Equipment Critical to the Waste Certification Program.”

Any piece of equipment that fails to meet continuing calibration requirements must be recalibrated, and all affected measurements, assays, or examinations made since the last calibration of that piece of equipment must be rerun.

3.6 DATA MANAGEMENT

Raw data obtained by testing, sampling, and analyzing low-level waste in support of waste characterization shall be identifiable, legible, and provide documentary evidence of quality. The reporting requirements at the data generation level are provided in Section 6 of this QAPP for each method used. All participating testing, sampling, and analytical facilities must use approved forms, provided in this QAPP or in the related SOPs, for reporting waste characterization data.

4.0 Sampling Process Design

The experimental design for the Program is shown in **Figure 4**. The design follows the data quality objectives specified in Section 1.5 of this QAPP.

It is important to note that "waste stream" is defined in the QAPP as waste material generated from a single process or activity. Waste may be generated as either process waste or batch waste streams. A "process" is defined as a system or series of continuous or regularly occurring actions taking place in a predetermined manner over extended periods of time, resulting in a product that is substantially uniform. A "batch" is defined as an amount of material subjected to a particular unit chemical process, unit physical mixing process, or other short-term operation, resulting in a final product that is substantially uniform.

4.1 PARAMETERS, RATIONALE, AND TEST METHODS

Table 5 shows the required sampling and analysis activities for legacy waste. All waste containers shall be characterized by either radiography, radioassay, or drum headspace gas sampling and analysis. In addition, a selected number of drums will be characterized by visual examination as required by Section 4.1.2. Other requirements are explained in Sections 5 and 6.

4.1.1 Process Knowledge

Knowledge of the original materials used and the operations that generated the debris waste streams (legacy waste) is sufficient to determine if the waste contains hazardous constituents (i.e., VOCs, SVOCs, PCBs, and metals). Therefore, RCRA waste characterization of debris waste shall be accomplished using process knowledge instead of sampling and analytical methods. The procedure used for documenting the process knowledge for legacy waste at LLNL is WCP-28, "The Characterization and Certification of Low-Level Legacy Waste." The form used for this documentation is shown in **Figure 5**.

4.1.2 Visual Examination

A statistically significant portion of the waste containers that are certified by radiography to be in compliance with waste acceptance criteria must be opened and visually examined. The visual examination must be used to determine, with acceptable confidence, what percentage of waste containers are miscertified, that is, they in fact do not meet the waste acceptance criteria of the disposal site.

For the first year of project activities, LLNL will use a historical miscertification rate of 2 percent (based on experience at Idaho National Engineering Laboratory) to calculate the number of waste containers that must be visually examined. Once the LLNL site-specific miscertification rate is determined, that rate must be used. **Table 6** specifies the number of waste containers that must be visually examined for different miscertification rates and waste container population sizes. (The calculations performed to generate **Table 6** and any other interpolated or extrapolated values are based on the hypergeometric probability distribution discussed in the *Transuranic Waste Characterization Quality Assurance Program Plan*(U. S. DOE, 1995). By statistically calculating the number of waste containers to be visually examined, the Program can be reasonably certain that the UCL_{90} of the miscertification percentage is less than 14 percent.

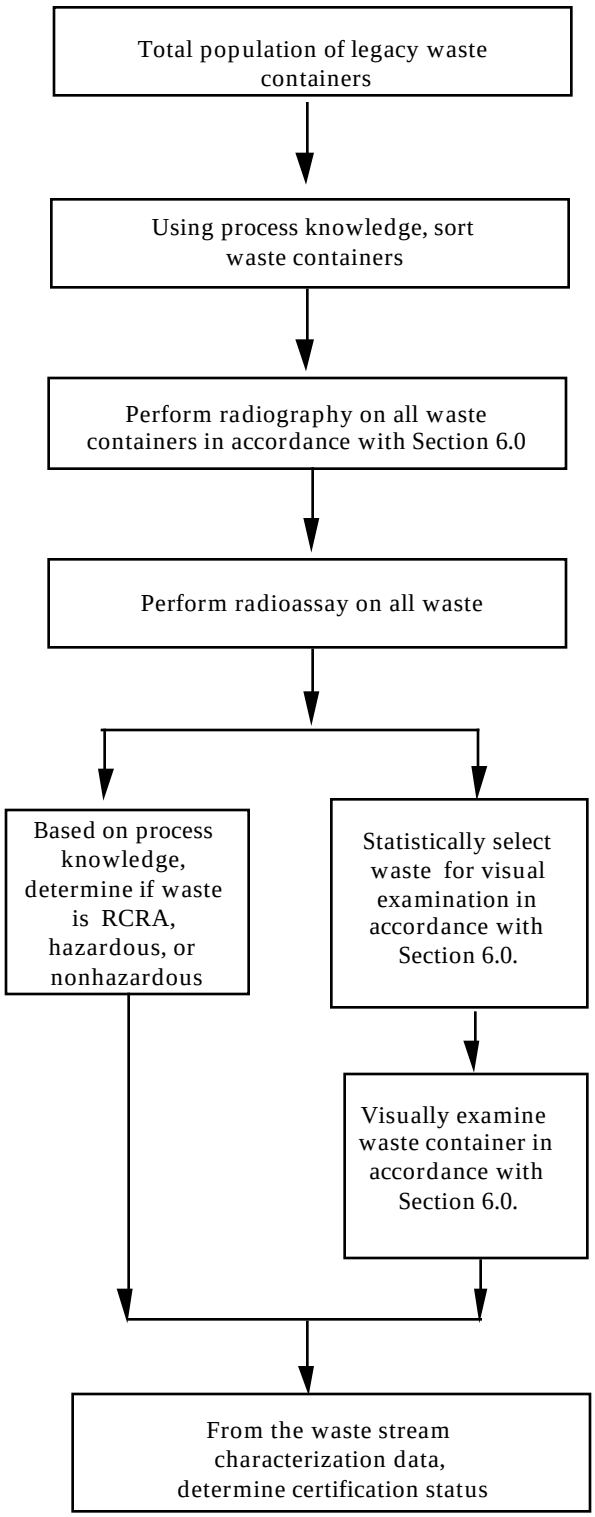

Figure 4. Experimental Design for the Low-Level Waste Characterization Project.

Table 5. Required Sampling and Analytical Activities for Legacy Waste.

Sampling and Analytical Method	Required
Radiography	X
Radioassay	X
Headspace gas sampling & analysis:	
Hydrogen/methane	n/a
Gas VOCs	a
Visual Examination	a
Total VOCs analysis	b
Total SVOCs analysis	b
Total metals analysis	b

[a]On selected drums.

[b] = RCRA waste characterization accomplished using process knowledge.

Legacy Waste Process Knowledge Evaluation

HISTORICAL INFORMATION

Section I

Building _____ Room/Process _____ **LWPKE #** _____

Spreadsheet attached ❑ Yes ❑ No Certified Requisition # _____

Original R Requistion #	Unacceptable	Hold Label Applied	Reason or Comments	WPS #
	❑	❑		
	❑	❑		
	❑	❑		
	❑	❑		
	❑	❑		
	❑	❑		
	❑	❑		

Description of action taken and or reevaluation documentation attached for any Requisitions marked as unacceptable: ❑ Yes ❑ No

Total number of original requisitions attached _____

Description of waste from original requisitions:

_____

Check all grades of Uranium or Plutonium indicated on original requisition:

❑ Depleted Uranium (U-235 < 0.7%)

❑ Natural Uranium (U-235 = 0.7%)

❑ Low Enrichment Uranium (U-235 < 5.0%)

❑ Weapons Pu (Pu-240 ≤ 6.0% + Am241 ≤ 1.0%)

❑ Fuel Pu (6.0% < Pu-240 ≤ 12.0% + Am-241 ≤ 1.0%)

❑ Reactor Pu (12.0% < Pu-240 ≤ 25.0% + Am-241 ≤ 1.0%)

❑ Am-Enriched Pu (Pu-240 ≤ 15.0% + 1.0% Am-241 ≤ 25.0%)

❑ Mixed Pu (15.0% < Pu-240 ≤ 50.0% + 1.0% < Am241 ≤ 25.0%)

List any other radionuclides listed on the original requisitions _____

_____

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Figure 5. Process Knowledge Evaluation Form (Example Only).

LEGACY WASTE PROCESS KNOWLEDGE EVALUATION (Continued)
VALIDATION

LWPKE # _____

Section II

Contact _____ Phone # _____ L-Code _____

Contact _____ Phone # _____ L-Code _____

Briefly describe the process conducted in the area that generated the Legacy Waste:

_____

_____

_____

_____

Date(s) the process took place _____

Were any RCRA or California listed or characteristic hazardous wastes generated as part of the process that created this waste? ❑ Yes ❑ No If yes, please describe:

_____

_____

_____

Is any of the following documentation regarding the process available to assist with characterizing the waste?

❑ Log Books	❑ Drawings	❑ FSPs
❑ Photos	❑ Personal Notes	❑ OSPs
❑ Mfg. Specs	❑ MSDSs	❑ SOPs

List any documentation used to characterize the Low-Level Legacy Waste:

_____

_____

What procedure(s) controlled the use and disposal of hazardous materials or wastes?

_____

_____

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Figure 5, Continued.

LEGACY WASTE PROCESS KNOWLEDGE EVALUATION (Continued)

LWPKE # _____

Does the Legacy Waste contain or is it likely to contain any:

Asbestos	❑ Yes	❑ No	Explosives	❑ Yes	❑ No
Chelating Agents < 1 %	❑ Yes	❑ No	Fine Particles	❑ Yes	❑ No
Classified	❑ Yes	❑ No	Free Liquids	❑ Yes	❑ No
Compressed Gases	❑ Yes	❑ No	PCBs	❑ Yes	❑ No
Etiological Agents	❑ Yes	❑ No	Pyrophoric	❑ Yes	❑ No

Comments _____

Process evaluation interview conducted Date: _____

Additional documentation attached. ❑ Yes ❑ No

PKE originator: Print Name Signature Date:

Section III **ENVIRONMENTAL REVIEW**

(To be completed by an Environmental Operations Group Analyst)

The following regulatory references in addition to 40 CFR and Title 22 were used to evaluate this LWPKE by the EA _____

- Process review walk-down conducted (Date) _____ ❑ Yes ❑ No ❑ NA
- Support documentation that was reviewed and attached ❑ Yes ❑ No ❑ NA
- Waste characterization memo attached ❑ Yes ❑ No ❑ NA
- List of personnel interviews conducted attached ❑ Yes ❑ No ❑ NA

Comments: _____

Based on the information provided on the LWPKE, unless the original requisition is marked unacceptable, the waste is: (Check appropriate box)

❑ Free of hazardous waste constituents

❑ Contains hazardous waste constituents, below regulatory limits

Environmental Analyst: Print Name Signature Date:

Section IV **WASTE CERTIFICATION OFFICIAL**

I have reviewed Sections I, II, III and found them to be complete and accurate. I have also reviewed any controls on hazardous materials mentioned in the interviews and/or historical information and found them acceptable.

Waste Certification Official: Print Name Signature Date:

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Figure 5, Continued.

Table 6. Number of Waste Containers Requiring Visual Examination[a]

Number of Waste Containers Undergoing Characterization Annually	Percent of Waste Containers Miscertified by Radiography					
	1%	2%	3%	4%	5%	6%
	Number of Waste Containers Requiring Visual Examination					
50	22[b]	22	22[b]	22	29[b]	29
100	15	24	24	33	33	41
200	15	26	26	35	44	52
300	15	26	26	35	44	53
400	15	26	26	36	45	62
500	16	26	26	36	45	63

[a]This is Table 5-1 of DOE, 1995.

[b]Number of containers for the higher even-number percent of miscertified containers is used because a percent implies a noninteger number of containers are likely to be miscertified.

5.0 Sample Handling and Custody Requirements

Note: At present, only real time radiography is addressed. The QAPP will be updated in the future to address other waste characterization techniques.

To ensure that waste characterization data meet accepted standards for legal admissibility and defensibility, field logs, sample labels, and chain-of-custody forms must be maintained and samples properly handled throughout the waste characterization process.

5.1 FIELD DOCUMENTATION

All containers that have been selected for real time radiography are listed and tracked in a data base maintained by the Waste Certification Program. The process begins when the Legacy Waste Coordinator schedules containers, selected by the Site Project Manager, for real time radiography. After radiography, the containers are segregated pending final certification. A low-level waste container custodian is assigned the responsibility for maintaining control over the containers and restricting access to them as required in WCP-28, “The Characterization and Certification of Low-Level Legacy Waste.”

5.2 LABELING

All low-level waste containers at LLNL are uniquely identified with an HWM label that describes the contents and cross-indexes the requisition number.

5.2.1 Waste Container Labeling

HWM affixes bar code labels with an identification number to the waste containers. The number is unique for each container and in some cases cross-indexes the requisition number.

5.3. CHAIN OF CUSTODY

Chain of custody on individual waste containers is initiated either at the time the waste is placed in a parcel package or drum or, in the case of low-level legacy waste, at the time real time radiography is performed. The seals applied to a waste parcel or container must be cut, torn, broken, or otherwise destroyed to open the waste parcel or container. Waste package seal numbers are recorded on parcel cards, waste containers, and, in the case of legacy waste, is tracked in the database and recorded on the Process Knowledge Evaluation form.

5.4 WASTE CONTAINER TRACKING

All containers selected for radiography are tracked using a tracking log sheet, shown in **Figure 6**. This log sheet displays the database fields used in tracking containers through the radiography process. The process is initiated when a Low-Level Legacy Waste Tracking Activity Request (**Figure 7**) is sent to the HWM facility supervisor to request real time radiography. After radiography, the waste package seal number is added to the request form, which is returned to the Waste Certification Program. If the container is segregated for any reason, it is so noted on the form.

Req. #	PKE #	RTR Schedule	RTR Approved	Sampling Approved	Rad Approved	Visual Required	Parcel #	WPS#	Cert. Date

Figure 6. Low-Level Legacy Waste Tracking Log Sheet (Example Only).

LOW-LEVEL LEGACY WASTE ACTIVITY REQUEST

PKE# _____ Completed By _____ Date _____

This form may be used to request any one or more of these activities

SECTION 1 CONTAINERS

❑ Spreadsheet attached

❑ Mark PKE # on container(s)

Current yard location _____

❑ Removed from PKE, segregate

❑ Schedule for RTR

Date _____

❑ Place WPS on container(s)*

*Note WPS #s on spreadsheet and return to LWCC

SECTION 2 SPECIAL WASTE

❑ Spreadsheet attached

❑ Schedule Sampling

Account Number _____

❑ HEPA Sampling

❑ Other special handling: _____

_____

SECTION 3 RADIOLOGICAL CHARACTERIZATION

❑ Spreadsheet attached

Health Physicist Name _____

❑ Schedule Rad Characterization **

Account Number _____

❑ HSNI # 331

❑ Headspace Gas Sampling

❑ Gamma Spec

❑ Survey

❑ Sampling required

❑ PKE Supplemental Radiological Characterization Form attached

**Results should be sent to LWCC

SECTION 4 EXCEPTIONS

❑ Spreadsheet attached

❑ Reevaluate container

❑ RTR results attached

❑ Section 3 (Rad Char) required

❑ PKE marked

❑ Visual examination

SECTION 5 APPROVAL

❑ Spreadsheet attached

❑ Containers approved for certification

❑ Container Packaging Instructions attached

❑ Prepare Low-Level Waste Parcel Card

Parcel card Number _____

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Figure 7. Low-Level Legacy Waste Request Form (Example Only).

6.0 Radiography

Radiography is a nondestructive, qualitative, and semiquantitative technique that involves x-ray scanning of waste containers to identify waste container contents. The results of radiography are verified through visual examination of a statistically selected subpopulation of waste containers in each waste stream.

Waste container contents are identified to ensure that they match the process knowledge evaluation and are in compliance with NVO-325 (i.e. , do not contain prohibited items). The radiography process encompasses a suite of activities: implementing radiography quality assurance objectives, performing the radiography and recording the radiographic scan, ensuring that operators are properly trained, and verifying the radiography data with visual examination data in accordance with Section 6.3**.** These activities are further described below.

6.1 QUALITY ASSURANCE OBJECTIVES

Data to meet radiography objectives at LLNL must be obtained from a recorded scan provided by certified radiographers. Results must also be recorded on a radiography data form (see Section 6.6). Precision, accuracy, completeness, and comparability of radiography data constitute the quality assurance objectives of radiography data. They are discussed below. Note that radiography does not have a specific method detection limit because it is primarily a qualitative determination.

If the quality assurance objectives are not met, the radiographers will work with the Site Project QA Officer to implement any corrective actions (e.g., additional operator training) needed.

6.1.1 Precision

The qualitative determinations made during radiography do not lend themselves to statistical evaluations of precision. However, previous testing at the Rocky Flats Plant and at the Idaho National Engineering Laboratory, in which radiography data were compared to the results of a visual examination of the waste containers, indicates that radiography can provide estimated inventories of waste items (Zeigler and Harder, 1993).

6.1.2 Accuracy

The accuracy with which the waste container contents can be determined must be documented through visual examination (see Section 6.3) of a randomly selected statistical subpopulation of drums (see Section 4.1.2). After visual inspection, the percentage of containers requiring a new description will be calculated and reported by the Site QA Officer as a measure of accuracy.

6.1.3 Completeness

A recording of the radiography examination and a radiography data form, validated according to the requirements in Section 2.0, must be obtained for all of the drums undergoing real time radiography at LLNL.

6.1.4 Comparability

The waste container contents determined by radiography must be compared with the waste container contents determined by visual examination (Section 6.3). The comparability of the generated radiography data must be enhanced by the use of standardized radiography procedures and qualified operators, in accordance with the requirements of this QAPP (see following sections).

6.2 METHODS REQUIREMENTS

Radiography is used by LLNL to aid in the examination and identification of the contents of waste containers. There is no equivalent or associated method found in EPA sampling and analysis guidance documents.

To perform radiography, the waste container is scanned while the operator views the video monitor. A recording is made of the waste container scan and is maintained as a permanent record (Section 1.7). A radiography data form is also used to document the waste container's contents. The radiography equipment and method are discussed briefly below.

LLNL is contracting with Advanced Systems Technology (AST) to supply necessary equipment and operators to perform radiography on radioactive waste drums at LLNL. This equipment will be housed in a contractor-owned and -operated trailer which will be set up adjacent to Building 625 at LLNL. The trailer is shielded to prevent exposure to personnel outside the radiography cell. AST will use an x-ray source with maximum power on the order of 320–420 keV and an imaging system which consists primarily of an image intensifier. The throughput of the system is approximately 25 drums per 8-hour shift. Drum motions consist of rotation, tilt, elevate, and translate.

AST will identify items in the drums such as free liquids, contained liquids, aerosol cans, suspected hazardous materials, etc. Output will consist of S-VHS videotapes containing the images of all examined drums. The sound track of these tapes will have voice annotations of the actual examination, with the operators identifying objects of interest or non-compliance. A video cursor and character generator will also be available for use in annotating the tapes during the examination.

6.3 QUALITY CONTROL

The radiography system involves qualitative and semiquantitative evaluations of visual displays. Operator training and experience are the most important considerations for assuring quality in radiography operation and for interpretation and disposition of radiography results. Only trained and approved AST personnel will be allowed to operate the radiography equipment. Standardized training requirements for these radiography operators will be based upon existing, industry-standard training requirements and must comply with the training and qualification requirements of NQA-1, Element 2 (ASME, 1994). All AST radiographers are certified Level II NDE Technicians in accordance with ASNT SNT-TC-1A. Requalification of these operators will be based upon evidence of continued satisfactory performance (primarily audio/videotape reviews) and will be performed at least every 2 years. Unsatisfactory performance will result in disqualification. Once disqualified, retraining and demonstration of satisfactory performance will be required before an

operator is again allowed to operate the radiography system. Training requirements and operator qualifications are covered in AST's standard operating procedures.

A test drum with various container sizes holding different amounts of liquid, penetrameters, wire gauges, simulated waste, etc. will be periodically scanned by each operator. The videotape of this scan will be reviewed to ensure that operators' interpretations remain consistent and accurate. This test drum will also be used to verify imaging system characteristics (functionality, resolution, etc.) of the monitoring system on a daily basis.

Independent replicate scans and replicate observations of the videotape output of the radiography process will be performed under uniform conditions and procedures. Independent replicate scans will be performed on one out of every twenty waste containers examined. Independent observations of one scan (not the replicate scan) will be made once during each work shift. Oversight functions include periodic audio/videotape reviews of accepted waste containers which are performed by personnel other than the operator who dispositioned the waste container. LLNL's Waste Certification Official or designee, in conjunction with the radiography operators' supervisor, will be responsible for monitoring the quality of the radiography data and calling for corrective action, when necessary.

As an additional QC check, the radiography results will be verified directly by visual examination, which will be performed on a statistically determined subpopulation of waste containers. The selection of waste containers for visual examination will be conducted in accordance with the procedure specified in Section 4.1.2 of this QAPP.

The visual examination will consist of a semiquantitative and/or qualitative evaluation of the waste container contents and will be recorded on audio/videotape. The visual examination program provides an acceptable level of confidence in radiography. There is no equivalent method found in EPA sampling and analysis guidance documents.

Figure 8 illustrates the overall programmatic approach to the visual examination of waste. A visual examination expert will determine the extent of visual verification needed. If the waste is homogeneous, the expert may decide that a limited visual examination involving a confirmation of the radiography data is appropriate. If the waste is heterogeneous, the expert may decide that a full visual examination, in which bags are opened and waste is segregated, is warranted. Various degrees of segregation are possible, based on the expert's judgment and availability of process knowledge data. LLNL's visual examination procedure, WCP-31 ("Data Validation of Real Time Radiography"), specifies the activities required to achieve the visual examination objectives, including documentation of the basis for the visual examination expert's decisions. A description of the waste container contents will be recorded on a data form as described in Section 6.6. The description can be brief, but it will clearly identify the waste.

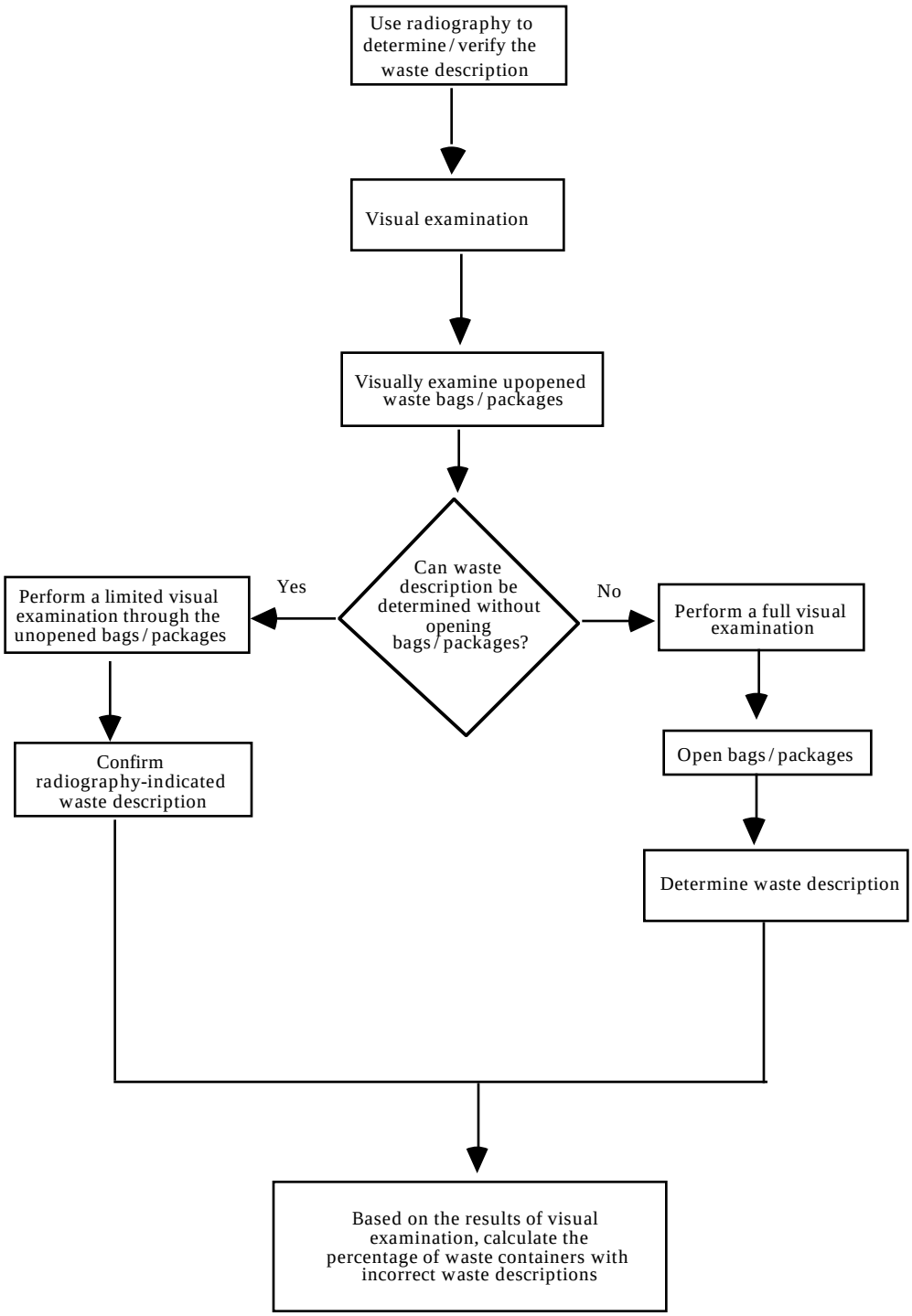

Figure 8. Overall Programmatic Approach to Visual Characterization of the Waste.

6.4 INSTRUMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

All equipment used during radiography will be tested, inspected, and maintained in accordance with manufacturer's instructions. The specific manufacturer's requirements are outlined in AST's procedure for radiography equipment testing, inspection, and maintenance.

6.5 INSTRUMENT CALIBRATION AND FREQUENCY

Periodic calibration of radiography equipment will be performed in accordance with AST's procedure specifying the radiography calibration process and frequency. When radiography equipment is in use, operational checks will be conducted at the beginning of each work day. These checks will also include observation of a test pattern to ensure that the radiography system has adequate video quality.

6.6 DATA MANAGEMENT

The results of the radiography examination for each waste container will be documented on a data form and be available to the data users. Recordings of radiographic examinations will be stored by the data generating facility, as specified in Section 1.6. The data reporting form requires the following information:

- Examining site
- Waste container identification number
- Date of radiography examination
- Estimated inventory of waste container contents (e.g., number/count of a particular waste item, as applicable)
- Description of content
- Audio/videotape identification number
- Operator signature/date
- Reviewer signature/date.

The current version of the radiography data form, containing all the information specified above as a minimum, will be completed and signed by the operator and the reviewer for each waste container. **Figure 9** is an example of the data form used by the real time radiography operator.

RTR DATA COLLECTION-LLW

Examining Site _____ Examination Date _____

Bar Code # _____ RTR Batch # _____

Requisition # _____ RTR Tape # _____

WPS # _____ Counter: _____

Replicate Scan ❒ Yes ❒ No Test Drum ❒ Yes ❒ No

1. Description of waste container contents: (check all that apply)

[ ] Low Z material (rags, wipes)	[ ] PPE	[ ] Glassware
[ ] Wood	[ ] Lead Lined Gloves	[ ] Pipe
[ ] Hose	[ ] Plastics	[ ] Tools
[ ] Wire	[ ] Vials	[ ] Ceramics
[ ] Thermocouples	[ ] Respirator Cartridges	[ ] Circuit Boards
[ ] Hardware (nuts, bolts, screws)	[ ] Concrete	[ ] Cans
[ ] High Z material (metal)	[ ] Chips/Turnings	

Other (describe)_____

_____

_____

2. Does waste match description on requisition? [ ] Yes [ ] No

If no, describe discrepancy_____

_____

_____

3. Waste container fill percentage: _____%

4. Have liquids been detected? [ ] Yes [ ] No

If yes, describe (free or container, container type, location, etc.)_____

_____

_____

Estimated Volume of liquids: [ ] <5ml [ ] >5ml and <100 ml [ ] >100ml

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Figure 9. Data Form Used for Real Time Radiography (Example Only).

5. Is evidence of particulates (fines <200 microns) present? [ ] Yes [ ] No

   In what form? [ ] Filter Material [ ] Sweepings

   Other (describe)_____

   _____

   _____

   Estimated volume: [ ] <5cm^3 [ ] >5cm^3 and <100cm^3 [ ] >100cm^3

6. Have any HEPA filters been detected? [ ] Yes [ ] No

   If yes, describe location, quantity, etc._____

   _____

   _____

7. Have any potentially pressurized containers (including aerosol cans) been detected? [ ] Yes [ ] No

   Is there visual evidence that all of these containers are vented? [ ] Yes [ ] No

   Describe location of these containers, type, quantity, puncture, disfigurement, etc._____

   _____

   _____

8. Is there any evidence of equipment that may contain PCBs? [ ] Yes [ ] No

   If yes, type: [ ] Transformers [ ] Capacitors

   Other (describe)_____

   _____

9. Other items detected:

   [ ] Lead [ ] Batteries [ ] Mercury [ ] Sharps

   Describe:_____

   _____

   _____

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Figure 9, Continued.

10. Was 100% of the container penetrated by the examination? [ ] Yes [ ] No

    If no, explain_____

    _____

11. Other comments_____

    _____

    _____

    _____

    _____

12. Radiographers name: _____ Date:_____

    Signature: _____

13. LLNL observer name: _____ Date:_____

    Signature: _____

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Figure 9, Continued.

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